AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS, INC.
1791 Tullie Circle, NE Atlanta, GA 30329 404-636-8400

TC/TG/TRG MINUTES COVER SHEET

(Minutes of all meetings are to be distributed to all persons listed below within 60 days following the meeting.)

TC/TG/TRG NO. TC 7.5 DATE: July 5, 2006

TC/TG/TRG TITLE: Smart Building Systems

DATE OF MEETING: January 24, 2006 LOCATION: Chicago, IL

Members Present	Appt	Members Absent	Appt	Ex-Officio Members and Additional Attendance
John House, Chair (V)	05-07	Osman Ahmed (V)	02-06	Peter Armstrong
Steve Blanc, (V)	04-08	Cliff Federspiel (V)	02-06	Martha Brook
Michael Brambley, Vice Chair, Research Subc., (V)	05-09			Bin Chen
Michael Brandemuehl	03-07	**Corresponding Members**		Mark Cherniack
James Braun (V)	03-07	Narendra Amarani, CM	04-	Krishnan Gowri
James W. Gartner (V)	03-07	Dave Branson, CM	01-	Ahmed Husaunndee
Bill Healy (V)	04-08	Marty Burns, CM	02-	Haorong Li
Agami Reddy (V)	02-06	Jim Butler, CM	02-	Larry Luskay
Jonathan Wright, IM (V)	03-07	Charles Culp, CM	00-	Janice Peterson
Peng Xu, Wireless Apps. Subc., (V)	05-09	Arthur Dexter, CM	05-	Tim Salsbury
		Mohsen Farzad	05-	Ashish Singhal
Corresponding Members		Carlos Haiad, CM	04-	Gene Strehlow
David Bornside, CM	04-	Mark Johnson, CM	04-	Li Zhang
Barry Bridges, CM	02-	George Kelly, CM	01-	
Natascha Castro, FDD Subc., Web Master, CM	04-	Mingsheng Liu, CM	03-	
Maria Corsi, CM	03-	Carol Lomonaco, CM	00-	
Piotr Domanski	05-	Darrell Massie, CM	03-	
Rich Hackner, Program Subc., CM	05-	John Mitchell , CM	00-	
Phil Haves, CM	05-	Ron Nelson, CM	98-	
David Kahn, CM	96-	Hung Mahn Pham, CM	01-	
Srinivas Katipamula; Bldg/Util. Int. Subc., CM	05-	Kinga Porst, CM	02-	
Michael Kintner-Meyer, CM	03-	Mike Pouchak, CM	03-	
Leslie Norford, Handbook Subc, CM	03-	Andrew Price, CM	03-	
Robert Old, CM	00-	Barry Reardon, CM	99-	
Glenn Remington, CM	02-	John Seem, CM	03-	
Todd Rossi, Secretary, CM	03-	James Winston, CM	96-	
Vern Smith, CM	05-	Xiaohui Zhou, CM	03-	
Pornsak Songkakul, CM	02-			
Keith Temple, CM	03-			
Jin Wen, CM	05-			
Chariti Young, CM	02-			

(V) = voting member

DISTRIBUTION:
ALL MEMBERS AND CORRESPONDING MEMBERS OF TC/TG/TRG,
TAC CHAIR: William Bahnfleth
TAC SECTION HEAD: Janice Peterson
ALL COMMITTEE LIAISONS AS SHOWN ON TC/TG/TRG ROSTERS:

Program: William Klock	Standards: Richard Hermans
Research: Patrick Hughes	Special Publications: Kimball Ferguson
CTT: Joseph Anderson	Staff Liaison (Stds): Claire Ramspeck
Prof. Dev.: Julian De Bullet	Staff Liaison (Resch/Tech Srvc): Michael Vaughn

ASHRAE TC Activities Sheet

DATE: January 24, 2006
TC NO. TC 7.5 TC TITLE: Smart Building Systems
CHAIR: John House VICE CHAIR: Mike Brambley

TC Meeting Schedule

Location, past 12 mo.	Date	Location, next 12 mo.	Date
Denver	6/28/05	Quebec City	6/27/06
Chicago	1/24/06	Dallas	1/30/07

TC Subcommittees

Subcommittee	**Chair**
Fault Detection and Diagnostics	N. Castro
Wireless Applications	P. Xu
Building/Utility Interface	S. Katipamula
Research	M. Brambley
Program	R. Hackner
Handbook	L. Norford

Program List for 2006 Quebec City Meeting:

Title	**Chair**	**Status**
"User Experience with HVAC Fault Detection and Diagnostics – Part I" - Seminar	M. Cherniack	
"User Experience with HVAC Fault Detection and Diagnostics – Part II" - Seminar	A. Thomle	
"Fault Detection and Diagnostics: Are You Ready to Put it in Your Building?" - Forum	M. Brambley	

Current Research Projects

1275-RP "Evaluation and Assessment of Fault Detection and Diagnostic Methods for Centrifugal Chillers – Phase II" (Phil Haves – PMSC Chair)

1274-RP "Field Performance Assessment of Package Equipment to Quantify the Benefits of Proper Service" (Todd Rossi – PMSC Chair)

1312-RP "Tools for Evaluating FDD Methods for AHUs" (Phil Haves – PMSC Chair)

2005 – 2006 Research Plan

Priority	**Project**	**Contributors**	**Status**
1	Fault Detection and Diagnostics for Centrifugal Chillers – Phase 3: Real-Time Implementation	WS Contributors Srinivas Katipamula. RTAR Contributors: Srinivas Katipamula, John House,	Draft WS developed; Katipamula incorporated responses to comments and Phase 2 update for Chicago meeting. Final draft is pending submission of 127-RP report. The plan is to submit this WS to RAC at the Quebec City meeting.

		Todd Rossi, Jim Braun, Natascha Castro	
2	Conceptual Design of a Self-Configuring HVAC Control System	Michael Kintner-Meyer	Revised draft WS discussed in Denver. Revisions planned. No new inputs at the Chicago meeting. The author wants to postpone further discussion.
3	FDD for Supermarket Refrigeration	RTAR Contributors Daniel Choinere and John House	Approved in Denver. No changes in Chicago.
4	Development of metrics to evaluate benefits of sensor networks in buildings (new title)	RTAR Contributors Jin Wen and Agami Reddy. Revised by Bill Healy	Approved by full TC in Denver with minor revisions. Received comments from RAC and will be revised accordingly.
5	"What If" Emulation Tool for Training and Strategizing on Building Operations	Steve Blanc	Revised draft of RTAR discussed at Chicago meeting. Holmberg will coordinate.
6	Whole-Building FDD	Les Norford	On hold. Les is still interested in pursuing the idea.
7	Smart Sensor Systems for Reducing Bias Errors in the Measurement of Air Temperatures and Flows in Air-Handling Units	Arthur Dexter and Phil Haves	Draft RTAR written. No progress to report. Bill Pienta from Siemens is interested in pursuing the idea. DROPPED from list in Chicago because of lack of champion.

Co-Sponsorship

	Real-Time Optimal Control in a Distributed Environment	Jim Braun, George Kelly, Maria Corsi	RTAR submitted by TC 7.4, TC 7.5 is co-sponsor. RTAR has been approved. No Progress to report.

Technical Papers from Sponsored Research

RP-1011

Final report for ASHRAE Research Project RP-1011, "Utility/Energy Management and Control Systems (EMCS) Communication Protocol Requirements" is available on the TC 7.5 web site.

RP-1020

Norford, L. K., J. A. Wright, R. Buswell, and D. Luo. 2000. "Demonstration of Fault Detection and Diagnosis Methods in a Real Building (ASHRAE 1020-RP)." ASHRAE 1020-RP Final Report.

Luo, D., L. K. Norford, S. R. Shaw, and S. B. Leeb. 2002. "Monitoring HVAC Equipment Electrical Loads from a Centralized Location - Methods and Field Test Results." ASHRAE Transactions Vol. 108(1).

Shaw, S. R., L. K. Norford, D. Luo, and S. B. Leeb. 2002. "Detection of HVAC Faults via Electrical LoadMonitoring." International Journal of HVAC&R Research, 8(1):13-40.

Norford, L.K., J. A. Wright, R. A. Buswell, D. Luo, C. Klaassen, and A. Suby. 2002. "Demonstration of Fault Detection and Diagnosis Methods for Air-Handling Units (ASHRAE 1020-RP)." International Journal of HVAC&R Research, 8(1):41-72.

RP-1043

Bendapudi, S., Braun, J.E., and Groll, E.A., "A Dynamic Model of a Centrifugal Chiller System – Model Development, Numerical Study and Validation," ASHRAE transactions, Vol. 111, Pt. 1, 18 pages, 2005.

Final report for ASHRAE Research Project RP-1043, " Fault Detection and Diagnostic Requirements and Evaluation Tools for Chillers" is available on the TC 7.5 web site.

Technical paper from 1043-RP, Comstock, M.C., Braun, J.E., and Groll, E.A., "The Sensitivity of Chiller Performance to Common Faults," International Journal of HVAC&R Research, Vol. 7, No. 3, pp. 263-279, 2001.

Technical paper from 1043-RP, Comstock, M.C., Braun, J.E., and Groll, E.A., "A Survey of Common Faults for Chillers," ASHRAE Transactions, Vol. 108, Pt. 1, 2002.

RP-1139

Andersen, K.K., and Reddy, T.A., 2002. "The Error in Variable (EIV) Regression Approach as a Means of Identifying Unbiased Physical Parameter Estimates: Application to Chiller Performance Data", International Journal of HVAC&R Research, vol.8, no.3, pp. 295-309, July.

Reddy, T.A. and Andersen, K.K., 2002. "An Evaluation of Classical Steady-state Off-line Linear Parameter Estimation Methods Applied to Chiller Performance Data", International Journal of HVAC&R Research, vol.8, no.1, pp.101-124.

Reddy, T.A., Niebur, D., Andersen, K.K., Pericolo, P.P. and Cabrera, G., 2003. "Evaluation of the Suitability of Different Chiller Performance Models for Online Training Applied to Automated Fault Detection and Diagnosis", International Journal of HVAC&R Research, Vol.9, No.4, pp. 365-384, October.

Reddy, T.A., Andersen, K.K. and Niebur, D., 2003. "Information Content of Incoming Data During Field Monitoring: Application to Online Chiller Modeling", International Journal of HVAC&R Research, Vol.9, no.4, pp.385-414, October.

TC Sponsored Symposia (past 3 years, present, planned)

Title	**Date** (Given or Planned)

FDD, Operation and Maintenance of HVAC Systems (Kelly, TC 1.4 co-sponsor)	Kansas City, 6/03
Automated Functional Testing: Methodologies and Air-Handling Unit Applications (House)	Orlando, 1/05
Software Tools for Building Commissioning (House)	Dallas, 1/07

TC Sponsored Seminars (past 3 years, present, planned)

Title	**Date** (Given or Planned)
Wireless Sensors for Building Applications (Healy, TC 1.4 co-sponsor)	Kansas City, 6/03
Improved Operations for California Buildings -Part 1 (Haiad, TC 7.4 lead)	Anaheim, 1/04
Improved Operations for California Buildings -Part 2 (Scruton, co-sponsored with TC 7.4)	Anaheim, 1/04
Automated Commissioning Tools (Maria Corsi, co-sponsored with TC 7.3)	Anaheim, 1/04
State of the Art Issues for DDC Systems (Atkinson, TC 1.4 lead)	Anaheim, 1/04
Models for Automated Building/HVAC Fault Detection and Diagnostics (Brambley, co-sponsored with TC 4.7)	Nashville, 6/04
Demand Response and Building Control (Xu, TC 7.4 lead)	Nashville, 6/04
Control Challenges and Opportunities with Emerging DDC Technologies (Bridges, TC 1.4 lead)	Orlando, 1/05
Future Intelligent Control Systems: They are Here Today (Braun, TC 7.4 lead)	Orlando, 1/05
Load Management: Why You Should Care and What Technology is Emerging (Katipamula, TC 1.4 and TC 7.4 co-sponsor)	Chicago, 1/06
User Experience with HVAC Fault Detection and Diagnostics – Part 1 (Cherniack, TC 1.4 and 7.6 co-sponsor)	Quebec City, 6/06
User Experience with HVAC Fault Detection and Diagnostics – Part 2 (Thomle, TC 1.4 and 7.6 co-sponsor)	Quebec City, 6/06

TC Sponsored Forums (past 3 years, present, planned)

Title	**Date** (Given or Planned)
Achieving Market Acceptance of HVAC Fault Detection and Diagnostic Systems (Goetzler, co-sponsored with TC 7.4)	Orlando, 1/05
What the utility wants to do to your building and how you will benefit (Kintner-Meyer, TC 7.4 co-sponsor)	Denver, 6/05
Wireless Sensing and Control: Where is it Needed and What Should it Control? (Brambley, TC 1.4 co-sponsor)	Chicago, 1/06
Fault Detection and Diagnostics: Are You Ready to Put it in Your Building? (Brambley, TC 1.4 and 7.6 co-sponsor)	Quebec City, 6/06

TC Sponsored Public Sessions (past 3 years, present, planned): None
Journal Publications (past 3 years, present, planned): None

ASHRAE TC 7.5, Smart Building Systems

January 24, 2006

Call to Order, Roll Call, Introductions

The meeting was called to order at 3:35 PM with Chairman John House presiding. Roll call was taken with 10 of 12 voting members in attendance. House distributed the Agenda (the call-to-meeting letter and the agenda are in Appendix A).

Voting members present: Steve Blanc, Michael Brambley, Michael Brandemuehl, James Braun, James Gartner, Bill Healy, Agami Reddy, Jonathan Wright, Peng Xu, and John House

Committee Scope

The Chair read the committee scope for the benefit of all in attendance. (see Appendix B)

Approval of Minutes

House asked for comments and changes to the Denver minutes. Mike Brambley noted that the minutes refer to electronic attachments that were not included when the minutes were emailed. Brambley also provided editorial changes.

Motion: Move to approve minutes subject to noted changes. Motion to approve minutes by Mike Brandemuehl; seconded by Jonathan Wright. **Vote:** 8-0-0; chair not voting.

Chair's Announcements – John House

1. New Committee Structure

   The three topical subcommittees have been renamed to correspond to the areas of research that are being pursued within the committee. The former names of the subcommittees were Technology Development, Communications and Integration, and Testing and Evaluation. The subcommittees are now Fault Detection and Diagnostics, Wireless Applications, and Building/Utility Interface. Program will continue to be handled as part of the topical subcommittee meetings.

   Topical subcommittee chairs are being asked to provide agendas for their meetings. These will be distributed via email two to three weeks prior to meetings.

2. Changes to ASHRAE Technical Program

   Symposia and Technical Sessions are being renamed as Transactions Sessions. Time slots for Seminars and Transactions Session will be 90 minutes with two or three speakers per session. For topics with more than three speakers, the Program Committee will schedule back to back sessions as part 1, part 2 sessions. Each session will need to be submitted online.

   Dedicated 1-hour time slots have been created for Forums. Depending on program demand and space availability, some sessions may be scheduled for Sunday afternoon from 3:30 – 5:00.

   Speakers can now submit their presentations online for commercialization review prior

to the meeting to avoid the need to do this in the Speaker's Lounge.
Discussion concerning the new program schedule ensued. In general the committee favored the changes; however, it felt the limitation of three speakers was too restrictive and four speakers should be allowed.

ACTION: House will write a letter to the Program Committee recommending that Transactions Sessions have up to four speakers for the 90 minute session.

3. Call for Papers/Sessions for Greenbuild 2006

   The U.S. Green Building Council is inviting proposals for presentations and sessions for Greenbuild 2006, to be held Nov. 15-17, 2006 in Denver. The deadline for submission is Feb. 3, 2006.

4. ASHRAE Security and Privacy Policy

   ASHRAE has a new Security and Privacy Policy that was approved by the Board of Directors last June. It deals with privacy issues related to providing information to and accessing information from ASHRAE, as well as using the ASHRAE web site.

   On a related topic, TC's are required to get permission from individuals before posting their phone number or email address on a TC Web Site.

5. Scoping Study for Measuring and Reporting the On-site Performance of Buildings

   A task force was formed to provide advice to Technology Council regarding the establishment of protocols for validating the performance of buildings, except low-rise residential buildings. Their recommendations include a consensus ASHRAE protocol that would be developed in the near term for rapid dissemination, followed by the establishment of an ASHRAE standard or guideline in the long term that would be based on existing ASHRAE standards, guidelines and other documents that provide a consistent method of measuring, expressing and comparing the energy use, water use, and indoor environment of buildings.

Fault Detection and Diagnostics Subcommittee – Natascha Castro

Natascha (Chair) reported that the Subcommittee met on Sunday to discuss three ongoing research projects, one draft work statement and three RTARs.

The first topic was a brief review of ongoing research projects

1. 1274 RP, "Field Performance Assessment of Packaged Equipment to Quantify the Benefits of Proper Service." [PMSC Chair: Todd Rossi]
   - Two-year project started in April 2004 and was scheduled to end in April 2006. There are concerns with the status of the project and a no-cost extension is going to be necessary.
   - Project involves field testing of 375 units to assess their performance (COP, capacity, identify faults). Then 75 of the units will be serviced and their performance re-evaluated to determine the improvement for eliminating faults. About half of the data has been collected.
   - Considerable time has been spent determining how to make the field measurements of COP and addressing reproducibility issues. No data was

presented dealing with the diagnostic conclusions, so questions arose as to how the service work was performed when the PI could not report the diagnostic conclusions.

- PMSC trying to bring the focus back to diagnostic issues. PMSC spent considerable time with the PI to address the issues.
- The PMSC is still expecting to get all data and results promised. The contractor is going to provide a plan for addressing the outstanding issues and provide this to the PMSC in the next month or so.
- The ensuing discussion raised the question of whether it was appropriate to consider an exit strategy if the contractor cannot get some of the identified issues resolved. Rossi said this has not been considered to this point. It was also suggested that the PMS monitor the payments to the contractor to ensure they are consistent with the amount of work completed.
- Additional notes are provided in Appendix H.

Motion: Move to recommend a no-cost time extension until April 30, 2007 for 1274-RP Field Performance Assessment of Packaged Equipment to Quantify the Benefits of Proper Service. Motion by Mike Brambley; Second by Steve Blanc. **Vote:** 9-0-0; chair not voting.

2. 1312 RP, "Tools for Evaluation FDD for AHUs" [PMSC Chair, Phil Haves]
   PMS 1312-RP Chicago Meeting- Monday 8-10a (Clark 7)
   - Started in fall, progressing well (Jin Wen PI)
   - Additional notes are provided in Appendix I.

3. 1275 RP, "Evaluation and Assessment of Fault Detection and Diagnostic Methods for Centrifugal Chillers - Phase II." [PMSC Chair, Phil Haves]
   PMS 1275 PMS 1275-RP Chicago Meeting- Sunday 1:00-3:00p
   - Status: Part 1 has progressed well. Part 2 is moving slowly and nearing end of original schedule. Need to evaluate dynamic model in the presence of faults.
   - Requesting no cost extension to July 31st, 2006.
   - Concern whether fault symptoms are specific to type of chiller and whether that is a limitation on phase III and whether it should be specified.
   - Additional notes are provided in Appendix J.

Motion: Move to approve a no-cost time extension until July 31, 2006 for 1275-RP Evaluation and Assessment of Fault Detection and Diagnostic Methods for Centrifugal Chillers – Phase II. Motion by Mike Brambley; Second by Steve Blanc. **Vote:** 8-0-1; chair not voting. Abstention by Agami Reddy, who is the PI for the project.

The second item of business was a discussion of a draft work statement

1. WS Chiller Phase III – Fault Detection and Diagnostics for Centrifugal Chillers, Phase III: Real Time Implementation. This work statement was championed by Srinivas Katipamula.
   - Plan to review in June and vote in Quebec City.
   - Recommend revising RTAR with new format and submit together with draft WS.

The third item of business was a brief update on the status of numerous RTARs. RTAR titles/topics, authors, and actions discussed follow:

1. "Fault Detection and Diagnostic Methods for Supermarkets" [RTAR Champion: John House (John Murray tc 10.7) –expertise and interest in developing workstatement.
   - Submitted to RAC, 2 comments (formatting) 2 on scope of work.

2. "A Building Systems Emulation Tool for Building Operators" [RTAR Champion: Steve Blanc]
    - A revised RTAR to be prepared for Quebec City (volunteer: David Holmberg)
3. "Smart Sensor Systems for Reducing Bias Errors in Measurement of Air Temperatures and Flows in AHUs"
    - RTAR has no champion and is being dropped from the current research topic list.

Wireless Applications Subcommittee – Peng Xu

Wireless is a new subcommittee at the Chicago meeting.
Existing Research Projects/Ideas:

- "Development of Metrics to Evaluate Benefits of Sensor Networks in Buildings" (Bill Healy).
- Michael Kintner-Meyer commented on the status of the workstatement titled "Conceptual Design of a Self-Configuring HVAC Control System". The workstatement has not progressed over the last several meetings and Kintner-Meyer suggested it would benefit from a review from other individuals on the committee or outside the committee with the relevant expertise. No volunteers were identified.

New Research Topics discussed in the meeting:

- Control network faulty behavior (Cliff Federspiel) ; trying to improve reliability of networks since they impact control performance – anyone interested should contact Federspiel or House
- Practical issues of using wireless technology in building control (Bob Old)

Building/Utility Interface Subcommittee – Srinivas Katipamula

Srinivas Katipamula informed the committee that the Building/Utility Subcommittee met for the first time on Sunday Jan. 21st, 2006. At the sub-committee meeting the objectives of the sub-committee as well as three potential research topics were discussed. One of the research topics was to explore development of standard communication objects between building control systems and utilities. Most members felt that it would be difficult to get a standard developed and TC 7.5 should concentrate on developing decision support systems/tools for building operators and managers. Katipamula informed the committee that at the next sub-committee meeting more time will be spent on exploring topics related to decision supports systems and tools for building operators/manager.

Srinivas Katipamula also asked the members to review the objectives of the subcommittee and provide feedback on any changes or additions.

Research Subcommittee – Mike Brambley

Mike Brambley made the following announcements from Research Subcommittee Chairs Breakfast Meeting

1. Reminder: Scoring of RTARs and WSs is heavily based on support for the ASHRAE Strategic Research Plan – 45%. It is important to list specific themes and goals supported by the project. Give details.

2. Currently there are more projects than funds.

3. An on-line research manual should be ready and online at Quebec City. RTAR and WS forms and examples and a research manual document are out there now. Use them. There are up-to-date forms.

4. New procedures will likely be approved on Wednesday morning for:

    a. Procedure if the lowest priced responsive bid is NOT selected.
    b. Procedure for avoiding actual or perceived conflicts of interest

    Conflicts of Interest Procedure

    A PES may recommend a bidder who participated in development of a WS in cases where all four of the following conditions are met:

    - There were a minimum of 3 authors who actively participated in the development of the work statement.
    - At least 3 responsive bids were received
    - The work statement author's bid attractiveness is not the result of his/her having a unique facility, equipment, or capability that is not explained and/or identified in the work statement and reasonably available to other bidders.
    - The work statement author's bid total cost is within 10% of the TC cost estimate provided in the work statement (i.e. not less than 10% lower to prevent bid rigging).

5. TC 8.2 would like us to consider co-sponsoring an RP.

Brambley then reported on the Research Subcommittee Meeting

1. John House explained the change in TC 7.5 subcommittees.
2. Most of the meeting was devoted to brainstorming on new ideas, leading to the 3 promising possibilities that follow.
    a. Peng Xu and Cliff Federspiel: Simultaneous heating and cooling. Investigate the current problem and propose a solution. Peng and Cliff will prepare a draft RTAR.
    b. Chris Scruton: System level diagnostics across air handlers. Chris will look at the old Hierarchical Conflict Resolution WS draft for similarities to see if this should be revived or a new RTAR developed. Brambley will provide that draft to Chris.
    c. Carlos Haiad: Controlling something besides HVAC, e.g., lighting for load control. Utility might control the load. A question: Can we do this kind of topic in ASHRAE? Rich Hackner will assist Carlos.

Program Subcommittee – Rich Hackner

Prioritized Program List for 2006 Quebec City Summer Meeting:

Priority 1 Seminar "*End Users Experience with Fault Detection and Diagnostics: Part 1*"
Chair: Mark Cherniack

Co-Sponsors: TC 1.4?, TC 7.3? and TC 7.6

Priority 2 Seminar *"End Users Experience with Fault Detection and Diagnostics: Part 2"*
Chair: Mark Cherniack
Co-Sponsors: TC 1.4?, TC 7.3? and TC 7.6

Priority 3 Forum *"Fault Behavior of Networks-Or How Does Murphy's Law Apply to Building Systems?"* (Chair: Cliff Federspiel)
Co-Sponsors: TC 1.5?

The prioritized research plan was approved by the committee.

Handbook Subcommittee Report – Les Norford

The focus of the work of the subcommittee continues to be to provide material on fault detection and diagnosis for consideration by TC 7.3, Operations and Maintenance Management, as it revises its handbook chapter. At the June 2005 ASHRAE meeting, TC 7.5 voted to endorse the submittal of material to TC 7.3; this material had been shared with TC 7.5 members prior to the meeting. Members of TC 7.3 reviewed the material and offered comments, asking that it be condensed.

A revised version was shared with the TC 7.3 handbook subcommittee chair prior to the Chicago meeting. In Chicago, the TC 7.3 handbook chair organized a review of the 7.3 chapter, with the goal of completing revisions by the end of March and asking the full TC to vote on the new chapter in Quebec City. The TC 7.5 handbook chair was invited to review portions of the chapter that concern maintenance and to incorporate his new material. Two other reviewers are active in TC 7.5; in total, about half of the review committee overlaps the two TCs.

The TC 7.5 handbook chair will share the 7.3 chapter as it is revised with the 7.5 chair and others who express interest.

Web – Natascha Castro

Nothing to report.

Homeland Security

Nothing to report.

Old Business

House congratulated Michael Kintner-Meyer and Marty Burns for having results of their work (1011-RP) improved for incorporation in the BACnet Standard.

New Business

House congratulated Jim Braun on being elected as a Fellow of ASHRAE. (applause) House also invited anyone interested in becoming a corresponding member of TC 7.5 to provide him with a business card with their ASHRAE member number.

House then opened a discussion of the subcommittee meeting schedule. There was some discussion of expanding the meeting lengths to allow more thorough discussion of research topics. Peng Xu suggested we should avoid having PMSC reports at the subcommittee meeting since these are provided in the main meting. House volunteered to set up a list server so that the committee could debate this issue between meetings.

Adjourn

Motion: Move to adjourn. Motion: Peng Xu (move); James Gartner (second). Motion approved by unanimous voice vote.

Appendices

A. Call to Meeting and Agenda
B. Scope and Organization
C. Fault Detection and Diagnostics Subcommittee Meeting
D. Wireless Applications Subcommittee Meeting
E. Building Utility Interface Subcommittee Meeting
F. Research Subcommittee Meeting
G. Program Notes
H. 1274-RP PMSC Notes
I. 1275-RP PMSC Notes
J. 1312-RP PMSC Notes
K. List of Subcommittee and Committee Attendees

Appendix A.
TC 7.5 Call to Meeting and Agenda

ASHRAE American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.

1791 Tullie Circle, NE, Atlanta, Georgia 30329-2305 404-636-8400 | Fax 404-321-5478

Reply to: John House
CANMET Energy Technology Centre
1615 Lionel-Boulet Blvd., P.O. Box 4800
Varennes, Quebec J3X 1S6
CANADA
John.House@NRCan.gc.ca

January 9, 2006

Dear TC 7.5 Member, International Member, or Corresponding Member:

The **TC** on Smart Building Systems will meet in the Palmer House Hilton in Chicago according to the following schedule:

TC 7.5	PMS 1274-RP	Saturday (1/21)	4:00-6:00p	Palmer House Hilton Lobby
TC 7.5	Fault Detection & Diagnosis	Sunday (1/22)	3:00-3:45p	Chicago (LL)
TC 7.5	Wireless Applications	Sunday (1/22)	3:45-4:30p	Chicago (LL)
TC 7.5	Building/Utility Interface	Sunday (1/22)	4:30-5:15p	Chicago (LL)
TC 7.5	Research	Sunday (1/22)	5:15-6:00p	Chicago (LL)
TC 7.5	PMS 1312-RP	Monday (1/23)	12:30-2:00p	Palmer House Hilton Lobby
TC 7.5	PMS 1275-RP	Tuesday (1/24)	1:30-3:00p	PDR 9 (3)
TC 7.5	**Smart Building Systems**	**Tuesday (1/24)**	**3:30-6:00p**	PDR 9 (3)

TC 7.5 is sponsoring the following program sessions:

Forum 19: Wireless Control: Where Is It Needed and What Should It Control?
Tuesday, January 24, 2006, 11:15 AM – 12:05 PM, Salon 7, Moderator: Michael Brambley

Seminar 55: Load Management: Why You Should Care and What Technology Is Emerging
Wednesday, January 25, 2006, 8:00 AM – 10:00 AM, Adams Ballroom Chair: Srinivas Katipamula

TC 7.5 is also co-sponsoring the following program sessions:

Seminar 2: Demand Response: What It Can Do for You
Sunday, January 22, 2006, 8:00 AM – 10:00 AM, Wabash Room, Chair: Michael Kintner-Meyer

Seminar 30: Using DDC Controls to Manage Resources for Green Buildings
Monday, January 23, 2006, 8:00 AM – 10:00 AM, Adams Ballroom Chair: Frank Shadpour

Symposium CH-06-07: Demand Response Strategies for Building Systems
Monday, January 23, 2006, 10:15 AM – 12:15 PM, Salon 12, Chair: Carlos Haiad

Attached is a draft agenda for the full TC 7.5 committee meeting. I hope to see you all in Chicago.

John House
Chairman, TC 7.5

ASHRAE TC 7.5, Smart Building Systems
2006 Winter Meeting
Chicago, IL

AGENDA

Location: **Palmer House Hilton**
Date: **Tuesday, January 24, 2006**
Time: **3:30 - 6:00 p.m.**

1. Roll Call and Introductions

2. TC 7.5 Scope

   TC 7.5 is concerned with the performance and interactions of smart building systems, the impact of smart systems on the total building performance, methods for achieving more intelligent control and operation of building processes, interactions of smart buildings with utilities, and documentation of the benefits of smart buildings and smart building systems as they relate to energy consumption, cost of operation, maintenance, occupant comfort, building commissioning, operations, and impact of the SBS on utilities and natural resources.

3. Approval of Denver Minutes

4. Announcements

5. Fault Detection and Diagnosis Subcommittee (Natascha Castro)
   - Report on 1274-RP "Field Performance Assessment of Package Equipment to Quantify the Benefits of Proper Service" (Todd Rossi – PMSC Chair)
   - Report on 1275-RP "Evaluation and Assessment of Fault Detection and Diagnostic Methods for Centrifugal Chillers – Phase II" (Phil Haves – PMSC Chair)
   - Report on 1312-RP "Tools for Evaluating Fault Detection and Diagnostic Methods for Air-Handling Units" (Phil Haves – PMSC Chair)

6. Wireless Applications Subcommittee (Peng Xu)

7. Building/Utility Interface Subcommittee (Srinivas Katipamula)

8. Research (Mike Brambley)

9. Program (Rich Hackner)
   - Plans for Quebec City and Dallas

10. Handbook (Les Norford)

11. Web (Natascha Castro)

12. Homeland Security

13. Old Business

14. New Business

15. Adjournment

Appendix B.
TC 7.5, Smart Building Systems Scope and Organization
Revised July 1, 2001

Overall Committee Scope

The Technical Committee on Smart Building Systems (SBS), TC 7.5, is concerned with the development and evaluation of technologies that could enable the widespread application of smart building systems. “Smart” buildings should take advantage of automation, communications, and data analysis technologies in order to operate in the most cost-effective manner. This implies integration of building services such as HVAC, fire, security, and transportation; the automation of many of the operation and maintenance functions traditionally performed by humans; and the interaction with outside service providers such as utilities, energy providers, and aggregators. Currently, three subcommittees form the backbone of the TC’s activities: fault detection and diagnostics, wireless applications, and building/utility interface.

Appendix C.
TC 7.5 Fault Detection and Diagnostics Subcommittee Meeting

Natascha (Chair) began the meeting with an overview of the agenda which included three ongoing research projects, one draft work statement and three RTARs.

The first topic was a brief review of ongoing research projects

- 1274 RP, "Field Performance Assessment of Packaged Equipment to Quantify the Benefits of Proper Service." [PMSC Chair: Todd Rossi]
  PMS 1274-RP Chicago Meeting- Saturday 4:00-6:00p
  - 375 rooftop units in 3 climates- determine faults based on data, then fix faults in 75 units and evaluated and document performance. ½ of data has been collected.
  - PMS discussion of COP measurements, repeatability issues, reproducibility. Some PMS concern of focus on these issues, and not on diagnostics.
  - Plan to turn in diagnostic plan to PMSC.
  - Several PMSC members to meet with PI to discuss strategy for diagnostics.
  - Request 1-year extension. Still expecting to get all data and results promised.

- 1312 RP, "Tools for Evaluation FDD for AHUs" [PMSC Chair, Phil Haves]
  PMS 1312-RP Chicago Meeting- Monday 8-10a (Clark 7)
  - Status:Started in fall, progressing well (Jin Wen PI) meetings by phone. PMS meeting Monday.
- 1275 RP, "Evaluation and Assessment of Fault Detection and Diagnostic Methods for Centrifugal Chillers - Phase II." [PMSC Chair, Phil Haves]
  PMS 1275 PMS 1275-RP Chicago Meeting- Sunday 1:00-3:00p
  - Part 1 develops assessment methodology, part 2, evaluate 4 methods & identify 2 suitable for phase III.
  - Status: Part 1 has progressed well. Part 2 is moving slowly and nearing end of original schedule. Need to evaluate dynamic model in the presence of faults.
  - Requesting no cost extension to July 31st, 2006.
  - Concern whether fault symptoms are specific to type of chiller and whether that is a limitation on phase III and whether it should be specified.

The second item of business was a discussion of a draft work statement

- WS Chiller Phase III – Fault Detection and Diagnostics for Centrifugal Chillers, Phase III: Real Time Implementation. This work statement was Championed by Srinivas Katipamula.
  - Test 2 methods in lab environment and in field on 3 chillers.
  - Discussion:Srinivas reported on significant changes, increase cost and duration. To 200k,24 months. Listing points that contractor will test in lab.
  - Whether to specify 2 methods or require one and let the other one be proposed by contractor. WS is fairly complete, but pending Phase 2.
  - Volunteer to review: ask Bill Mcquade (8.2 representative on PMS) [from main meeting Phil Haves]
  - Plan to review in June and vote in Quebec City.
  - Specify 3 chillers or specify 3 different chillers, phase 2 contractor states that it may be of value to specify different chillers be tested. (size, type of control, and speed) Blanc recommends Specifying categories.
  - Recommend revising RTAR with new format and submit together with draft WS.

The third item of business was a brief update on the status of numerous RTARs. RTAR titles/topics, authors, and actions discussed follow:

- "Fault Detection and Diagnostic Methods for Supermarkets" [RTAR Champion: John House (John Murray tc 10.7) –expertise and interest in developing workstatement.
    - Submitted to RAC, 2 comments (formatting) 2 on scope of work.
    - Who would be the end producer (vendor?)
    - EPRI- could be a good source of data.
- "A Building Systems Emulation Tool for Building Operators" [RTAR Champion: Steve Blanc]
    - "what-if emulator for buildings" help of training, operation, fdd- connected to the real building operation system. Not a proof of concept, but how to develop something that can be turned into a tool- a high-order specification.
    - volunteers: David Holmberg
- "Smart Sensor Systems for Reducing Bias Errors in Measurement of Air Temperatures and Flows in AHUs"
    - RTAR has no champion and is being dropped from the current research topic list.

The fourth item of business was a discussion of program.

- (Quebec City) Mark Cherniac presented a new idea for a seminar: "Fault Detection and Diagnostics: End-users reality report: How is it working?"
    - Results of PIER research, four speakers identified
- Symposium *Automated Commissioning…From the Case Files of IEA Annex 40*
    - Lead: John House, Only have 2 papers at present, Co-sponsors: 7.9?
- (Future) Seminar:*FDD…Fault Detection and Diagnostics…but What about "Correction?"*
    - Lead: Someone from PNNL? 2 presentations, Blanc may add one.Co-Sponsors: TC 7.4?

Program package deadlines for Quebec City: Tech Papers Due for Review Sept 23, 2006, Completed Packages Due Feb. 10, 2006.

Appendix D.
TC 7.5 Wireless Applications Subcommittee

1. Introduction
Peng introduced the history of the subcommittee and how the new subcommittee formed. He led a discussion of the title of the subcommittee. Should we keep the name of wireless or make it broader. John House, Steve Blanc, and Michael Brambley commented that we should keep the title as wireless now and the title can be changed later depending on the interests of participants.

2. Current Research Topics
2.1 Development of metrics to evaluate benefits of sensor networks in buildings.
Bill Healy is not in the meeting and Mike talked about the comments Bill received from RAC and Bill Haley's reply to the comments.

Cliff Federspiel asked a few questions and made it clear that the RTAR is not limited to the wireless technology. It can be any sensor network.

Comments from one of the RAC members: Most of the comments are from each individual member rather than the consensus of the RAC. Some comments might contradict each other. The author does not have to consider everything and he should use his own judgment in addressing the comments.

John: Ask Bill to email the updated RTAR to the TC.

2.2 Conceptual design of a self-configuring HVAC control system.

Michael: He did not receive feedback from other members in the TC. He might have to put the RTAR on hold unless he receives enough supports.

Comments: The plant process world is doing the same thing and it is only a matter of time that the same thing will happen in HVAV industry.

3. New research topics

Cliff: Control network fault behavior. Wireless network is more unreliable than the conventional network. It is worthy to investigate the faulty behavior of the sensor network.
Steve Blanc: CSCO should be the right person to talk with.
Cliff is going to write an RTAR for discussion next time.

Bob: Practical issues of using wireless technology in building control. He is going to write a few paragraphs to discuss next time.

4. Program
Forum: Control network faulty behavior (Cliff Federspiel)
Seminar: practical experience of wireless and control network in building. (Mike Brambley) (Long Beach).

Appendix E.
TC 7.5 Building/Utility Interface Subcommittee Meeting

The meeting began at 4:40 p.m. and there were about 30 people in attendance. Please refer to the main TC committee minutes for attendance list.

Srinivas Katipamula, the subcommittee chair, began the meeting, announcing that the TC Chair created this new sub-committee is response to members request to re-focus the research areas. Since this is the first meeting for the sub-committee, the subcommittee chair drafted a draft scope and asked the members to provide feedback and changes by email. The draft objectives of the subcommittee are:

> This new subcommittee will explore and develop ideas and research work statements to improve the building and utility interactions (and more specifically the electric grid). The research will focus on developing enabling technologies for seamless interaction of smart building components and utilities and other building services. An important aspect of this work is to identify the information that is necessary to support smart building technologies, and to identify the requirements of communication protocols to support the exchange of this information between different building services, between buildings and utilities, between multiple buildings, with outside service providers.
>
> The importance of a stable and reliable electric power grid to life and the economy in the 21st century has been underscored by two major events over the last decade: a major blackout on the east coast of North America and wildly varying electricity prices in California during an attempt at restructuring the electricity marketplace. In response to these events, many organization (DOE, EPRI, and CEC) have started research activities to find ways to modernize the grid. However, there are significant gaps in the research activities, especially as they relate to buildings. Since buildings consume over 70% of the electric in the U.S., they have to be part of the solution to modernize the grid. ASHRAE has traditionally developed technologies, standards, and guidelines for buildings. Therefore, this subcommittee can play a major role in continuing this effort.

After introducing the objectives, the subcommittee chair listed three potential research topics for discussion:

1. Building/Utility Communication for DR Program – Commercial Buildings
2. Building/Utility Communication for DR Program – Residential Buildings
3. Decision support to building operators (DR Programs, RTP, TOU)

David Holmberg who is with the BACnet committee was given the opportunity to provide a brief summary of activities currently underway in the BACnet committee to address topic one above. David indicated that we need a pricing object in BACnet. He indicated that there are two things that we need to consider: 1) can we work with the utilities to develop a standard object, and 2) how do we develop a BACnet object.

David indicated that there is currently an activity in California called Open AMI (Advanced Metering Infrastructure), which is defining use cases, data exchange, communication across application, security and network management issues.

After considerable discussion on this topic, the members concluded that it would be difficult to work with the utilities to come up with a standard definition of the object. Steve Blanc indicated that it would be better for the subcommittee and the BACnet committee to concentrate their efforts on the customer end and not get involved with the utility end for now. Mike Brambley and Cliff Federspiel agreed with the suggestion and suggested that we look at two or three different scenarios of communication rather than developing a standard communication mechanism.

Mike Brambley suggested that we stick to topic three on the list and develop some ideas around that topic.

The committee members also suggested the subcommittee chair also take a close look at the scope of the subcommittee in light of today's discussion.

Appendix F.
TC 7.5 Research Subcommittee Meeting

Mike Brambley reviewed the agenda and asked for revisions. Rich Hackner, Program Subcommittee Chair, requested time for discussion of program related to research. Brambley suggested eliminating the fourth item on the meeting agenda, which was a brief report by the topical subcommittee chairs, because those subcommittees had just met prior to the research subcommittee meeting, and placing Program related to research in that slot. Hearing no objections, Brambley made the change to the meeting agenda.

Announcements:

John House announced a US Department of Energy meeting on "Commissioning, Diagnostics, and Operations & Maintenance" to be held Monday from 2:00 to 4:00 pm at McCormick Place.

Brambley asked the topical subcommittee chairs to please provide him updates on status for the TC 7.5 Research Plan before the full committee meeting on Tuesday on the Research Plan sheet.

John House reported on the change in subcommittee names and structure, which had been implemented for the subcommittee meetings held early in the day. John provided a summary of the discussions at the last meeting and online leading up to this change, the rationale behind it, how it could be used flexibly, and the topical subcommittee leadership as follows:

Fault Detection and Diagnostics – Natascha Castro
Wireless Applications – Peng Xu
Building/Utility Interface – Srinivas Katipamula

Marty Burns suggested that the committee might want to consider broadening the Building/Utility Interface topic to "Owner and Non-Owner." Discussion followed. Then John H. indicated the committee would try the current structure for now, but could make changes at any time as the focus of the committee's research and programs changes.

Program Related to Research:

Rich Hackner held a discussion of program ideas related to TC 7.5 research. Program suggestions evolving from that discussion will be reported by Rich in his report at the full TC 7.5 meeting on Tuesday afternoon and in his contributions to the minutes.

Brainstorming:

Peng Xu suggested that the committee should consider research into the simultaneous heating and cooling problem. He pointed out that there are many systems with terminal reheat that have the chiller and boiler operating at the same time. He suggested the committee undertake developing a project to investigate this problem and develop solutions to it. Peng Xu and Cliff Federspiel volunteered to prepare a draft RTAR on this topic for review at the next meeting.

Chris Scruton observed that diagnostics for air handlers exists now, but there is a need for

system-level diagnostics across air handlers. These would be diagnostics at a higher level. John House suggested that Chris take a look at the old Hierarchical Conflict Resolution WS draft for similarities to see if this should be revived or a new RTAR developed. Brambley offered to send the last draft of that work statement to Chris.

Carlos Haiad introduced the idea that TC 7.5 look at controlling something other than air conditioning, e.g., lighting. It could investigate load control methods such as dimming. Utility might control the load. Chris Scruton suggested possibly investigating daylighting/lighting interactions. Carlos raised the question regarding whether we successful get this kind of research topic funded by ASHRAE? Rich Hackner offered to assist Carlos in investigating this.

Peter Demanski asked whether such research would support the strategic plan because this is a major factor in obtaining a good evaluation of a proposed project. John House observed that maybe this topic would support sustainability, a major thrust in ASHRAE currently and in the research plan. Scruton observed that reducing lighting loads leads to reduced AC loads, which would seem to fall directly in the purview of ASHRAE.

Carlos Haiad agreed to write a short description of this topic. Rich Hackner volunteered to help Carlos. Cliff Federspiel suggested that lighting/daylighting would tie into envelope actuation, which might be part of the BACnet scope and, therefore the BACnet committee should be contacted.

The meeting adjourned at 6:00 p.m.

Appendix G.
Program Notes

History

Priority 1 Seminar *"Electric Load Management: Why Should You Care and What Technologies are Emerging to Help You"* (Chair: Michael Brambley and Srinivas Katipamula)
Co-Sponsors: TC 7.4
Status: **Seminar 55, Wednesday, January 25th, 8:00-10:00 am, Adams Ballroom, 6th Floor**

Priority 2: Symposium *"Demand Response What it Can Do For You?"* (Chair: Michael Kintner-Meyer)
Status: **Seminar 2, Sunday, January 22nd, 8:00-10:00am, Wabash Room 3rd Floor**
Approximately 40 attendees

Priority 3 Seminar *"Economic Value of FDD ….Who Benefits? ..and How Much?"* (Chair: Phil Haves)
Co-Sponsors: TC 7.4
Status: **Not accepted???**

Priority 3: **Replaced with: Forum "Wireless Sensing and Control: Where is it Needed and What Should it Control? Michael Brambley**

Forum 19, Tuesday, Janury 24th, 11:15-12:05, Salon 7 3rd Floor

Other: **Co-sponsored with TC 1.4**
Seminar 30 "Using DDC Controls to Manage Resources for Green Buildings Monday, January 23rd, 8:00-10:00 am, Adams Ballroom 6th Floor
Approximately 50 attendees

MEETING SITE AND DATE	DATE TECHNICAL PAPERS ARE SUBMITTED TO BEGIN REVIEW PROCESS	DATE FOR ALL COMPLETED SYMPOSIUM, SEMINAR AND FORUM PACKAGES TO BE SUBMITTED and TECHNICAL PAPERS TO FINISH REVIEW
Chicago, Illinois January 21-25, 2006	April 1, 2005	August 5, 2005
Quebec City, Canada June 24-28, 2006	September 23, 2005	February 10, 2006
Dallas, Texas January 27-31, 2007	April 7, 2006	August 4, 2006
Long Beach, California June 23-27, 2007	September 29, 2006	February 9, 2007

Other Ideas for Quebec and Beyond

Seminar
Practical Experiences with Wireless Sensors in Buildings
Leads: Michael Brambley and Michael Kintner-Meyer

Co-Sponsors: ?

Forum
What are your Needs to Support Your Interactions with Your Utility
Lead: ???
Co-Sponsors: ?

Seminar
FDD…Fault Detection and Diagnostics…but What about "Correction?"
Lead: Someone from PNNL?
Co-Sponsors: TC 7.4?

Seminar
Peel and Stick….The Future in HVAC Sensing Technology?
Lead: Michael Brambley
Co-Sponsors: TC 1.4?
Possible Speakers: Mike Schell and Glen Remington

Forum
FDD Needs for Data Centers
Lead: Phil Haves
Co-Sponsors: TC 7.4, TC 9.9 Mission Critical Facilities?

Forum
What Makes a Smart Building "Smart""
Lead: ???
Co-Sponsors: TC 7.4

Appendix H.
1274-RP PMSC Notes

Todd Rossi described:

- Michael Kintner-Meyer: Develop exit strategy.
- Watch payments, consistent with % done. Talk with Mike Vaughn.
- Mike Brambley, Steve Blanc: PMS talks without contractor about exit strategy.
- Mike Brandemeuhl: May be premature to talk about exit strategy. Holding up future TC projects.
- Mike Brambley, Keith Temple: Concerned about value of data after reanalyzed. What work was done? What if they are not consistent with audit?
-

Move that TC 7.5 request no cost time extension until 4/30/07 for contractor of 1274-RP. Mike Brambley (move), Steve Blanc (second). Vote by hands: 9-0-0; chair not voting.

Appendix I.
1275-RP PMSC Notes

The project has developed a methodology for comparing and evaluating fault detection and diagnosis (FDD) methods for chillers and applied the methodology to four data-driven FDD methods for centrifugal chillers. Laboratory data from a chiller with various faults have been used in the testing. The nature of these data limits the evaluation criteria to the ability to detect and diagnose faults in so far as they impact efficiency. One concern is that the fault symptoms extracted from the laboratory data may be specific to particular chiller designs/manufacturers.

One task remaining is to use the dynamic chiller model developed in 1043-RP to characterize the effect of different faults on the dynamic response of the chiller, in particular the settling time after a load change. This information is intended to assist the development and testing of steady state detectors for use with FDD methods based on steady state performance.

Only modest progress has been made since the Denver meeting. The contractor requested a no-cost extension until July 31, 2006.

Appendix J.
1312-RP PMSC Notes

Tools for Evaluating Fault Detection and Diagnostic Methods for Air-Handling Units

The aim of the project is to develop and validate a simulation-based test environment for fault detection and diagnosis methods and tools for air handling units. The contractor is Drexel University, the PI is Jin Wen and the project started in September, 2005.

The simulation will use HVACSIM+ (a modular simulation program developed at NIST, similar to TRNSYS but with more robust numerical capabilities) and will build on the work of 825-RP. The dynamic cooling coil model developed in 1194-RP will be included. The HVAC system and component models will be validated experimentally at the Iowa Energy Center.

The project has got off to a good start. A literature survey of available component models, AHU faults and their impacts and available fault models and fault data has been completed. Simulation model requirements have been defined, including simulation platform (HVACSIM+) and programming language (Fortran), test environment structure, faults to be modeled and AHU configuration and control.

Appendix K.
List of Subcommittee and Committee Attendees

Chicago, IL – January 2006

	Main Committee	Fault Detection & Diagnostics	Wireless Applications	Building / Utility Interface	Research
Voting Members					
Osman Ahmed (V)					
Steve Blanc, (V)	X	X	X	X	
Michael Brambley, Vice Chair, Research Subc., (V)	X	X	X	X	X
Michael Brandemuehl (V)	X	X			
James Braun (V)	X	X	X		
Cliff Federspiel (V)		X	X	X	X
James W. Gartner, (V)	X	X			
Bill Healy (V)	X				
John House, Chair (V)	X	X	X	X	X
Agami Reddy (V)	X				
Jonathan Wright, International Member (V)	X	X	X	X	
Peng Xu, Wireless Apps. Subc., (V)	X	X	X	X	X
Non-Voting Members					
Eric Adams					
Narendra Amarnani					
Peter Armstrong, CM	X	X			
Gaylen Atkinson	X				
Don Aumann					
Kim Barker					
David Bornside	X		X		X
Dave Branson, CM					
Rob Braun					
Mark Breuker					
Barry Bridges, CM	X			X	X
Martha Brook	X	X		X	X
Marty Burns,CM			X	X	X
Jim Butler, CM					
Par Carling					
Natascha Castro, Testing & Eval Subc, Web Master	X	X	X	X	X
Bin Chen	X				
Mark Cherniack	X				
Daniel Choiniere					
Christian Christiansen					
Maria Corsi, CM	X	X	X	X	X
Yujie Cui					
Charles Culp, CM					
Arthur Dexter, CM					
Sharon Dinges					
Piotr Domanski	X	X	X	X	X
Mohsen Farzad					

	Fault Detection & Diagnostics	Wireless Applications	Building / Utility Interface	Fault Detection & Diagnostics	Research
Theo Frutiger					
John Gallaher					
Krishnan Gowri	X			X	
Rich Hackner, Prog. Subc., CM	X	X	X	X	X
Carlos Haiad		X	X	X	X
David Hansen					
Philip Haves, CM	X	X			
Kirstin Heinemeier					
Gregor Henze					
David Holmberg		X	X	X	X
Ahmed Husaunndee	X	X	X	X	X
Mark Johnson					
David Kahn, CM	X				
Srinivas Katipamula, Bldg./Util. Int. Subc., CM	X	X	X	X	X
George Kelly, CM					
Richard Kelso					
Michael Kintner-Meyer	X	X	X		
Hofu Kiu					
Curtis Klaassen					
Erin Kruse					
Thoi H. Le					
Damian Ljungquist					
Carol Lomonaco, CM,					
Haorong Li	X	X	X	X	X
Mingsheng Liu					
Larry Luskay	X				
Tor Malmstron					
Rodney Martin					
Glen Mason		X	X		
Darrell Massie					
Robert McDowall					
Chris Miller					
John Mitchell , CM					
Dan Mort					
Ron Nelson, CM					
Les Norford	X				
Zach Obert					
Robert Old, CM	X	X	X	X	X
Vance Payne					
Hung Mahn Pham, CM					
Bill Peinta					
Janice Peterson	X				
Kinga Porst, CM					
Michael Pouchak					
Andrew Price					
Barry Reardon, CM					
Wayne Reedy					
Paul Reimer					

	Fault Detection & Diagnostics	Wireless Applications	Building / Utility Interface	Fault Detection & Diagnostics	Research
Glenn Remington, CM	X	X	X	X	X
Todd Rossi, CM, Secretary	X	X	X		
Tim Salsbury	X				
Jeffrey Schein		X	X	X	X
Chris Scruton					X
John Seem, CM		X			
Virgil Seribo					
David Shipley					
Ashish Singhal	X	X			
Vernon Smith	X	X	X	X	X
Pornsak Songkakul, CM	X				
Gene Strehlow	X	X	X		
Kris Subbarao		X			
Changlin Sun					
Steven Szymurski					
Peter Tsilivis					
Keith Temple	X				
David Thompson				X	
Matthew Tyler, CM					
Dave Uden		X	X		
Hossein Vaezi-Nejad					
Arun Vohra					
Dave Underwood					
Jean Christopher Visier					
Jin Wen	X	X	X	X	X
Jonathan West					
James Winston, CM					
Hofu Wu		X	X	X	X
Chariti Young, CM	X				
Miao Yang					
David Yashar		X	X	X	
Jensen Zhang					
Song Zhang					
Li Zhang	X				
Xiaohui Zhou					